

The opinion in support of the decision being entered today was **not** written for publication and is **not** binding precedent of the Board.

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES

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*Ex parte* APOSTOLOS VOUTSAS

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Appeal No. 2005-0453  
Application No. 09/893,866

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ON BRIEF

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Before OWENS, TIMM, and DELMENDO, *Administrative Patent Judges*.  
TIMM, *Administrative Patent Judge*.

***DECISION ON APPEAL***

This appeal involves claims 1-23 which are all the claims pending in the application. We have jurisdiction over the appeal pursuant to 35 U.S.C. § 134.

### ***INTRODUCTION***

The claimed invention relates to the production of a crystallized silicon film for use in polycrystalline thin film transistors (TFTs) of active matrix (AM) liquid crystal displays (LCDs) (specification, p. 1, ll. 5-10). It is known in the art that silicon films enriched with a small amount of a trace impurity, such as nickel (Ni), can be annealed more quickly than pure silicon films due to the catalytic action of the impurity on the crystallization process (specification, p. 1, ll. 12-16). According to the specification, introduction of the impurity into the silicon has conventionally been accomplished using: (1) an impurity-rich liquid coating on the silicon film; (2) an evaporated impurity layer on the silicon film; and (3) by implanting the impurity into the silicon film (specification, p. 1, l. 16 to p. 2, l. 5). In Appellant's process, the impurity is introduced during a sputtering process wherein a target material including the impurity is sputtered onto a substrate. Because the target material includes the impurity, the sputtered layer of silicon includes the impurity incorporated therein (specification, p. 7, ll. 18-23). Claims 1 and 12 are illustrative of the invention on appeal:

1. In the fabrication of liquid crystal displays (LCDs), a method for forming silicon films with a controlled amount of trace impurities, the method comprising:
  - forming a target including silicon and a first concentration of a first impurity;
  - supplying a substrate; and
  - sputter depositing a film of silicon on the substrate including a second concentration of the first impurity.

12. In the fabrication of liquid crystal displays (LCDs), a method for depositing silicon films with trace impurities, the method comprising:

supplying a substrate; and

sputter depositing silicon and a controlled amount of a first impurity on the substrate.

The Examiner maintains rejections over prior art and, as evidence of unpatentability, the Examiner relies upon the following prior art documentation:

Zhang et al. (Zhang)	5,569,936	Oct. 29, 1996
Yamazaki et al. (Yamazaki)	6,306,694	Oct. 23, 2001
Admitted prior art, specification, p. 4, line 5		

The specific rejections maintained by the Examiner are as follows:

1. Claims 1-3, 12, and 14 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Zhang.
2. Claims 4, 5, 11, 13, and 15-18 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Zhang.
3. Claims 6, 8, 9, 19, 21, and 22 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Zhang in view of Yamazaki.
4. Claims 7, 10, 20, and 23 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Zhang in view of Yamazaki and further in view of the Admitted Prior Art.

Appellants state that claims 1-11 stand or fall together and that claims 12-23 stand or fall together (Brief, p. 4). It appears from the arguments that the grouping is meant to apply to the anticipation rejection. For the anticipation rejection, therefore, we will select claims 1 and 12 to

represent the issues on appeal. For each of the other rejections, we will select one of the rejected claims to represent the issues on appeal.

Substantially for the reasons advanced by the Examiner in the Answer, we affirm. We add the following primarily for emphasis.

### ***OPINION***

#### ***Anticipation by Zhang***

The Examiner rejects claims 1-3, 12, and 14 under 35 U.S.C. § 102(b) as being anticipated by Zhang. Zhang describes employing a crystallization catalyst to promote crystallization in a silicon film. Similarly to Appellant, Zhang intends to use the crystallized region of the silicon which contains the catalyst as a crystalline silicon TFT of an active matrix (AM) circuit of an LCD (Zhang, abstract; col. 1, ll. 8-22). The catalyst is an “impurity” within the meaning of Appellant’s claims (Zhang, col. 1, ll. 46-53). Zhang describes several methods for introducing the impurity into the silicon film including a sputtering method in which the impurity is added to the sputtering target (Zhang, col. 3, ll. 62-65).

Appellant argues that the disclosure of sputtering in Zhang neither teaches all the elements of the invention of claims 1 and 12 nor enables one of ordinary skill in the art to perform the process of the claims (Brief, pp. 4-6). The focus of these arguments is on the limitations directed to the concentration of the impurity.

The Examiner has provided sufficient reason to conclude that all the limitations of the claimed process are present in the process of Zhang including the concentration limitations (Answer, pp. 6-10). While not expressly articulated in the reference, the concentration requirements of claims 1 and 12 are inherently met by the process of Zhang (Answer, pp. 7-8 and 9-10). Zhang describes forming the film by sputtering wherein the catalyst is added to the sputtering target. Adding the catalyst to the target necessarily would result in a first concentration of impurity in the target as required by claim 1. Performing sputtering using the described target necessarily would result in a second concentration of impurity in the resultant sputtered film as further required by claim 1. Moreover, the sputtering process inherently controls the amount of the impurity on the substrate as required by claim 12 due to the inherent rates of sputtering exhibited by silicon and the impurity.

Zhang need not expressly articulate the concentration requirements to establish a *prima facie* case of anticipation, it is enough that there is a reasonable basis to conclude that the claimed limitations are inherently met. *In re Best*, 562 F.2d 1252, 1254-55, 195 USPQ 430, 432-34 (CCPA 1977). In such circumstances, it is reasonable to shift the burden to the Appellant to prove that, in fact, the prior art sputtering process does not necessarily or inherently meet the concentration requirements of the claims. *Best*, 562 F.2d at 1254, 195 USPQ at 433. Appellant has not provided the required level of proof to overcome the reasonable conclusion of inherency.

With regard to the enablement of a reference, a reference is presumed to be enabling and therefore, once the examiner establishes that the reference teaches each and every limitation of

the claimed invention, the burden shifts to the applicant to prove the reference is not enabling. *Chester v. Miller*, 906 F.2d 1574, 1578, 15 USPQ2d 1333, 1337 (Fed. Cir. 1990); *In re Sasse*, 629 F.2d 675, 681, 207 USPQ 107, 111 (CCPA 1980). Appellant provides no convincing proof that Zhang is not enabling.

As a second matter, the Examiner further provided a reasonable basis to conclude that one of ordinary skill in the semiconductor device forming art would have been in possession of the claimed invention upon a reading of Zhang (Answer, p. 6-10). Zhang specifically describes sputtering wherein the impurity is added to the target (Zhang, col. 3, ll. 62-65). As explained by the Examiner, and further supported by Appellant's specification, sputtering was a conventional process in the art (Answer, p. 6-7; specification, p. 4, l. 23 to p. 7, l. 17). In such a circumstance, Zhang need not provide an express articulation of the details of the sputtering operation to enable one of ordinary skill to perform the operation because it is evident that those of ordinary skill in the art possessed the knowledge. *See In re Donohue*, 766 F.2d 531, 533, 226 USPQ 619, 621 (Fed. Cir. 1985).

We conclude that the Examiner established a *prima facie* case of anticipation with respect to the subject matter of claims 1-3, 12, and 14 which has not been sufficiently rebutted by Appellant.

#### ***Obviousness over Zhang***

The Examiner rejected claims 4, 5, 11, 13, and 15-18 under 35 U.S.C. § 103(a) as being unpatentable over Zhang. We select claim 4 to represent the issues on appeal for this rejection.

In the process of claim 4, the impurity is nickel (Ni) and it is present in the target in a concentration of 0.01 to 0.5 atomic percent (at %) and present in the deposited film in a concentration of 0.01 to 0.5 at %.

Both the Appellant and the Examiner agree that Zhang identifies nickel (Ni) as useful as the impurity and that Zhang teaches a concentration range of  $1 \times 10^{17} \text{ cm}^{-3}$  or more for the resulting film (Answer, p. 3 and p. 10; Brief, pp. 6-7). The Examiner acknowledges that the concentration of Ni in the target is not identified by Zhang (Answer, p. 10). It is the Examiner's position that one of ordinary skill in the art would have had the level of skill required to optimize the concentration levels through routine experimentation to obtain the desired level of crystallization enhancement (Answer, p. 4).

Appellant argues that the Examiner has not met the three requirements of a *prima facie* case as articulated in MPEP § 2143 (Brief, pp. 7-10). In response to what the Appellant calls the "optimization of ranges" rejection, Appellant further argues that the prior art reference must present either a broader or alternative range of variables which, Appellant believes, is required in such a rejection (Brief, p. 9).

We do not find Appellant's arguments convincing. A claim is unpatentable as obvious "if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art." 35 U.S.C. § 103(a) (2002). Here, the "difference" relates to the concentration levels of the Ni. Zhang describes the inclusion of Ni in the target and its

inclusion is for the same function as disclosed by Appellant, i.e., to enhance crystallization of the silicon film. That Zhang does not explicitly disclose the concentration level in the target is of no matter because Zhang teaches the general conditions of the process for the same result as Appellant. In this situation, those of ordinary skill in the art would have performed routine experimentation to find the optimal concentration in the target that would result in the optimal film concentration for the crystallization effect desired in the film. Further, there is no *per se* requirement that the reference articulate a numerical range for the variable at issue. *See In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955). Each case should be decided on its own facts.

Where, as here, the prior art acknowledges that the variable has effects, there is motivation to conduct routine experimentation to optimize those effects to get the expected benefits. There is also a reasonable expectation of success based on the known relationship between the variable and the expected effect. It is true that a routine variable change sometimes causes an unexpected effect. In such a situation, the claimed subject matter will be unobvious under the law if Appellant provides evidence of an unexpected beneficial result. *See In re Boesch*, 617 F.2d 272, 276, 205 USPQ 215, 219 (CCPA 1980). Note also *Aller*, 220 F.2d at 456, 105 USPQ at 235. No such evidence has been presented here. Appellant directs us to page 8, lines 5-15 (Brief, p. 8), a discussion of sputtering yield, but there is no discussion there of an unexpected result.



We conclude that the Examiner has established a *prima facie* case of obviousness with respect to the subject matter of claims 4, 5, 11, 13, and 15-18 which has not been sufficiently rebutted by Appellant.

***Obviousness over Zhang in view of Yamazaki***

The Examiner rejected claims 6, 8, 9, 19, 21, and 22 under 35 U.S.C. § 103(a) as being unpatentable over Zhang in view of Yamazaki. We select claim 8 to represent the issues on appeal for this rejection. Claim 8 limits the impurity to germanium in a concentration of 5-30 at % in the target and 5-30 at % in the film. The Examiner relies upon Yamazaki as evidence that it was known in the art of TFT production to use germanium as a crystallization catalyst in silicon films (Answer, p. 5).

Appellant argues that the Examiner has not provided a motivation to combine the Zhang and Yamazaki references (Brief, pp. 11-12). Appellant further argues that even if the references could be combined, there is nothing in the Yamazaki disclosure to suggest a modification of Zhang in a way that would make the claimed invention of either claim 1 or claim 12 obvious (Brief, p. 12).

There is a reason, suggestion, or motivation to use germanium as the catalyst in the process of Zhang. Zhang describes using as the catalytic material “a simple substance like nickel (Ni), iron (Fe), cobalt (Co), platinum (Pt), or compound such as silicide thereof.” (Zhang, col. 3, ll. 50-53). The use of the word “like” indicates that the specific elements recited are merely examples and not an exclusive list. Yamazaki indicates that, in addition to nickel, iron, and

cobalt, other elements including germanium are useful as a catalytic element for promoting the crystallization of an amorphous silicon film (Yamazaki, col. 7, ll. 35-42). The references together provide a suggestion of using germanium as the catalytic impurity with a reasonable expectation of success in obtaining the desired catalytic affect.

Nor can we agree that one of ordinary skill in the art would not have made the modification called for by the claims. Once one of ordinary skill in the art knew that germanium was useful as the catalyst, that person would have performed routine experimentation to find the optimal concentration within the target which would result in the optimal film concentration, i.e., the film concentration which results in the desired crystallization enhancement.

We conclude that the Examiner has established a *prima facie* case of obviousness with respect to the subject matter of claims 6, 8, 9, 19, 21, and 22 which has not been sufficiently rebutted by Appellant.

***Obviousness over Zhang in view of Yamazaki and the Admitted Prior Art***

Claims 7, 10, 20, and 23 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Zhang in view of Yamazaki and further in view of the Admitted Prior Art. We select claim 7 to represent the issues on appeal. Claim 7 specifies that the sputtering is performed “using a process selected from the group including pulsed and non-pulsed direct current (DC) sputtering.”

As a first matter, the words “selected from the group *including*” do not limit the claim to the recited sputtering processes. Other sputtering processes may be encompassed by the claim. On the current record, however, the open ended nature of the claim group does not affect our

review. That is because the Examiner has established the obviousness of using pulsed DC sputtering in the process of Zhang. As pointed out by the Examiner, Appellant's own specification states that "[t]he usual type of sputtering used in commercial applications is DC magnetron sputtering, which is limited to the sputtering of metallic target [sic]." (specification, p. 5, ll. 3-5). We further note that the specification indicates that non-pulsed DC sputtering was also standard (specification, p. 7, ll. 24-26).

Appellant argues that there appears to be no motivation to combine the three references nor any reasonable expectation of success (Brief, p. 14). But Zhang specifically calls for sputtering and, therefore, one of ordinary skill in the art would have looked to conventional sputtering operations to perform the process of Zhang. The Examiner has provided sufficient evidence that both pulsed and non-pulsed DC sputtering were known in the art. The express suggestion in Zhang of using sputtering coupled with the evidence that pulsed and non-pulsed DC sputtering were known in the art provides the required suggestion of using those sputtering techniques in the process of Zhang with a reasonable expectation that the desired film would be created by the process.

We conclude that the Examiner has established a *prima facie* case of obviousness with respect to the subject matter of claims 7, 10, 20, and 23 which has not been sufficiently rebutted by Appellant.

***OTHER ISSUES***

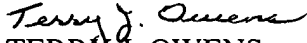
Upon further prosecution, the Examiner may wish to determine whether the phrase “process selected from the group including” in claim 7 renders claim 7 indefinite under 35 U.S.C. § 112, ¶ 2. The key question is whether the word “including” opens the group up to other unrecited forms of sputtering such that one of ordinary skill in the art would not be reasonably apprised of the scope of the claim. *See In re Warmerdam*, 33 F.3d 1354, 1361, 31 USPQ2d 1754, 1759 (Fed. Cir. 1994)(The legal standard for definiteness is whether a claim reasonably apprises those of skill in the art of its scope.).

***CONCLUSION***


To summarize, the decision of the Examiner to reject claims 1-23 under 35 U.S.C. § 103(a) is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a).

AFFIRMED

  
TERRY J. OWENS  
Administrative Patent Judge

  
CATHERINE TIMM  
Administrative Patent Judge

  
ROMULO H. DELMENDO  
Administrative Patent Judge

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